AL.2.1998-246
c.2
[1]

MATHEMATICS 14

TEACHER MANUAL

CLASSROOM ASSESSMENT MATERIALS

0
OREGON
RULE
CO.
1
GON RULE CO.
1
U.S.A.
2

MATHEMATICS 14

Teacher Manual

CLASSROOM
ASSESSMENT
MATERIALS

Alberta
EDUCATION

Copyright © 1997, the Crown in Right of Alberta, as represented by the Minister of Education, Alberta Education, 11160 Jasper Avenue, Edmonton, Alberta T5K 0L2. All rights reserved.

No part of this work may be reproduced or transmitted in any form or by any means, electronic, mechanical, recording or otherwise, or by any information storage and retrieval system, without permission in writing from the Minister of Education.

Teachers may photocopy "Student Materials" as required for educational use.

Additional copies may be purchased from Education Advantage Inc. and/or from the Learning Resources Distributing Centre.

Canadian Cataloguing in Publication Data

Main entry under title:

Mathematics 14

(Classroom Assessment Materials Project (CAMP))
Compiled by Alberta Education, Student Evaluation Branch.
Contents: Teacher manual - Student materials - Examples of students' responses.
ISBN 1-55249-067-X (set) -
ISBN 1-55249-064-5 (Teacher manual) -
ISBN 1-55249-065-3 (Student materials) -
ISBN 1-55249-066-1 (Students' responses)

1. Mathematics--Alberta--Examinations.
2. Academic achievement--Alberta--Testing.
3. Education, Secondary--Alberta--Evaluation.
I. Education Advantage (Firm). II. Alberta. Student Evaluation Branch.
III. Title: Mathematics fourteen.. IV. Series.

QA43.M3314 1997 510'.76 C97-900125-0

Printed and Bound in Canada

Manufactured and Distributed by:

Education Advantage Inc.
Edmonton AB

Cover Illustrated by Hung Lee, a student from
Eastglen High School, Edmonton.
Teacher Mr. G. Prokop.

The Classroom Assessment Materials

Background

The Classroom Assessment Materials Project (CAMP) was launched in 1994 in response to Alberta Education's goal of establishing and effectively communicating clear learning outcomes and high standards for each area of learning. As well, the project is a response to teachers' ongoing requests for high-quality assessment materials to use in their classrooms. CAMP also addresses the need for a common understanding of provincial standards that is frequently expressed by parents, teachers, school administrators, and other public spokespeople.

Although Alberta teachers and Alberta Education developed the Classroom Assessment Materials for teachers to use in Alberta's schools, educators from other provinces and countries have indicated that these materials have considerable potential for their jurisdictions.

Development

Alberta Education staff have worked closely with teachers from all over Alberta to design and develop the Classroom Assessment materials. A project advisory committee with representation from key education organizations, including the Alberta Teachers' Association, provided essential advice and direction for the overall shape and philosophy of the project. Teachers have contributed in numerous and invaluable ways. They have:

- selected resource material and data bases
- developed questions and activities
- validated materials
- offered their time and classrooms for field testing and pilot testing
- provided advice about administration and manageability
- served on revision committees
- provided advice regarding the articulation of expectations from grade to grade/course to course and across subjects
- written and revised scoring criteria
- selected examples of students' work and written commentaries about them
- confirmed that the standards represented and expressed in the final materials are appropriately demanding, faithful to *Program of Studies* expectations, and clearly expressed or illustrated.

Without the dedication and professionalism of Alberta teachers, this project would not have happened.

Purpose of the Classroom Assessment Materials

The Classroom Assessment Materials are summative assessment packages. They are designed to be used by classroom teachers to assess students' achievement of the learning outcomes specified in the *Program of Studies* relative to clearly stated standards.

The assessment activities in the CAMP materials are designed to be administrated in a classroom setting at times that suit the needs of the teacher and her or his students. The materials are not suitable for any other assessment purpose (e.g., diagnostic assessment, pre-instruction assessment, evaluation of instructional practice, system-wide assessment, program evaluation, teacher evaluation), and therefore they may not be used for any purpose imposed by any authority external to the classroom.

Contents of Each Set of Classroom Assessment Materials

Each set of Classroom Materials contains three "documents":

- a *Teacher Manual* with complete information about the assessment activities, their relation to the *Program of Studies*, the weighting of assessment components, statements of standards, and administration instructions including scoring criteria and details for calculating students' marks
- complete *Student Materials*—all of the information, tests, and booklets that students will need for each component
- *Examples of Students' Responses* that show actual student work in relationship to the scoring criteria, along with explanatory commentary

For each grade, subject, and/or course, there are several assessment components that work together to provide teachers and parents with a broadly based portrait of a student's achievement of the expectations for students learning at the end of that grade/course.

Each set of assessment materials includes a variety of activities—selected-response questions, short written-answer questions, extended writing activities, performance tasks such as lab experiments, problem-solving activities, and oral presentations. All activities are designed to interest students and to be of direct and practical use for teachers. All are directly related to learning outcomes from the *Program of Studies*.

Effective Use of the Classroom Assessment Materials

Teachers may use the Classroom Assessment Materials whenever they want to find out about a student's performance in relation to set standards for the end of that grade/subject/course. The materials were developed with the following questions in mind:

- What knowledge, skills, and attitudes should a student have firmly in place before he or she moves to the next grade or course?
- How well should students completing the learning outcomes for a particular grade/subject/course do what is expected of them?
- What does acceptable work for a grade/subject/course look like?
- What does excellent work for a grade/subject/course look like?

Teachers may administer the components in whatever order suits their classroom assessment needs; however, the components are designed to be used together. Only the complete set of assessment activities will provide a portrait of how well a student has met the standards for that grade/subject/course. Teachers may photocopy the materials as their needs require.

Acknowledgements

This project has come to be because of the remarkable cooperation of school jurisdictions, hundreds of teachers and principals, and thousands of students. From everyone on the project teams—thank you.

The project teams also wish to thank the following organizations without whose consultation and advice the project would not have progressed:

Alberta Teachers' Association
Alberta School Boards' Association
College of Alberta School Superintendents
Alberta Assessment Consortium
Universities Coordinating Council
Association canadienne-française de l'Alberta
Public Colleges and Technical Institutes of Alberta

The Alberta Education CAMP team members from the *Curriculum Standards Brach, Alberta Distance Learning Centre, Language Services Branch,* and the *Student Evaluation Branch*.

CAMP Project Leaders
Frank Horvath and Elana Scraba

CAMP Subject Coordinators

English Language Arts	Elana Scraba
Mathematics	Hugh Sanders
Science	Greg Hall, Greg Thomas, Bernie Galbraith
Social Studies	Doug Burns

Contents

The Mathematics 14 Classroom Assessment
Overview of the Assessment 3
Components of the Assessment 3
Definitions and Terminology 4
Blueprint of the Assessment 6
Description of Standards 9
Relationship of Assessment Standards to General Learner Expectations 11

Administering and Scoring the Assessment Components
General Scoring Criteria for Mathematical Content 17
General Scoring Criteria for Communication Skills 18

End-of-Course Exam
Administration 19
Item Summary 19
Written Response 1: Student Task and Solution 21
Task-Specific Scoring Criteria 22
Written Response 2: Student Task and Solution 23
Task-Specific Scoring Criteria 25
Written Response 3: Student Task and Solution 26
Task-Specific Scoring Criteria 27

Performance Assessment
Administration 28
Task 1: Objects in a Measuring Cylinder
Student Task and Solution 29
Task-Specific Scoring Criteria for Task 1 31
Task 2: Determining the Area of a Quadrilateral
Student Task and Solution 33
Task-Specific Scoring Criteria 35
Task 3: Does One 12-Sided Die Equal Two 6-Sided Dice?
Student Task and Solution 37
Task-Specific Scoring Criteria 40

Calculating and Recording Student Achievement
Standards for Overall Performance on the Assessment 45
Class Record Form 46
Item Summary – Overall Assessment 47
Directing Words 48

In addition to the Teacher Manual, the Mathematics 14 Classroom Assessment Materials includes a complete set of Student Materials and Examples of Students' Responses in separate booklets.

The Mathematics 14 Classroom Assessment

- *Overview of the Assessment*
- *Components of the Assessment*
- *Definitions and Terminology*
- *Blueprint of the Assessment*
- *Description of Standards*
- *Relationship of Assessment Standards to General Learner Expectations*

Overview of the Assessment

The NCTM *Assessment Standards for School Mathematics (1995)* states that:

- multiple sources of assessment information should be used to evaluate student progress in mathematics
- there is a shift in the vision of learning mathematics toward investigating, formulating, representing, reasoning, and applying a variety of strategies to the solution of problems
- there is a shift in the role of teachers toward "questioning and listening" and away from "telling" students what to do
- there is a shift in the vision of evaluation toward a system based on evidence from multiple sources

In keeping with this vision, the assessment tasks in this package range from an end-of-course exam including selected-response questions and problem-solving, written-response questions, to tasks that are *performance-based*. The performance assessment provides students with an opportunity to demonstrate their understanding of the mathematical process more fully than they are able to on the end-of-course exam.

Type of Assessment	Part/ Activity	Time	Mark Allocation	Total Marks
End-of-Course Exam	Selected Response Written Response	2 h	41 15	56
Performance Assessment	3 contexts: Marbles in a Jar Music Tastes Frequency Distributions	1.5 h	 8 8 8	24
TOTAL		3.5 h		80

Components of the Assessment

The Mathematics 14 assessment consists of the following components:

- an end-of-course exam consisting of 41 selected-response and three written-response questions
- a performance assessment, which consists of three tasks, designed to be completed by students individually

Definitions and Terminology

The Alberta Education *Course of Studies* for Mathematics 14 is defined by the learner expectations, what the student is expected to know and be able to do.

Standard

A *standard* is a reference point used in planning and evaluation. A standard defines the quality of a performance, product, or service that is considered acceptable, or that is considered to be excellent.

In evaluating educational performance, the following forms of standards apply:

- *curriculum* and *assessments standards* apply to the assessment of individual students
- *achievement standards* apply to the assessment of student populations

In this document, only curriculum and assessment standards will be discussed.

Curriculum Standard

A curriculum standard is a set of learner expectations for a module, course, or grade level of a program. The curriculum standards for Mathematics 14 are defined by the general learner expectations outlined on page 3 of the Course of Studies, and the specific learner expectations outlined on pages 7 to 15 of the Course of Studies.

Learner Expectations

General learner expectations are concise statements identifying what it is that students are expected to know, be able to do, and be like upon completion of a module, course, or grade level of a program.

Specific learner expectations are the component knowledge, skills, and attitudes that contribute to general learner expectations. Specific learner expectations identify a range of contexts in which the general learner expectations apply.

Assessment Standards

Assessment standards are the criteria used for judging individual student achievement relative to the curriculum standards and are noted in the assessment standard section of this document. Assessment standards have three components:

- *Criteria* are descriptors of student performance that indicate a standard has been met. Specific criteria may take on the form of task-specific criteria for a particular question or general scoring criteria used in assessing performance on a range of tasks.
- *Examples* are evidence of the quality of student work.
- *Guidelines for assessment and reporting* consist of information and advice for educators, to ensure consistency in assessment and reporting.

Assessment Instrument

An *assessment instrument* is a group of questions or tasks given to students to ascertain whether or not each has met the requirements of the acceptable standard or the standard of excellence.

Blueprint

A *blueprint* is a classification of the questions or tasks making up a particular assessment instrument. The classification may be in terms of question style (routine or non-routine), content sections (either topics or titles), or mathematical understandings (concepts, procedures, problem solving), or any other such classification.

Scoring Criteria

Scoring criteria consist of a set of descriptors of qualities of work for a particular extended-response question. These may later be converted to marks for reporting purposes.

Mathematical Understandings

The assessment of students' knowledge of *mathematical procedures* should provide evidence that they can:

- recognize when a procedure is appropriate
- give reasons for the steps in a procedure
- reliably and efficiently execute procedures
- verify the results of procedures empirically (e.g., using models) or analytically
- recognize correct and incorrect procedures
- generate new procedures and extend or modify familiar ones
- appreciate the nature and role of procedures in mathematics

The assessments of students' knowledge and understanding of *mathematical concepts* should provide evidence that they can:

- label, verbalize, and define concepts
- identify and generate examples and non-examples
- use models, diagrams, and symbols to represent concepts
- translate from one mode of representation to another
- recognize the various meanings and interpretations of concepts
- identify properties of a given concept and recognize conditions that determine a particular concept
- compare and contrast concepts

The assessments of students' ability to use mathematics in *solving problems* should provide evidence that they can:

- formulate problems
- apply a variety of strategies to solve problems
- solve problems
- verify and interpret results
- generalize solutions

(From *Curriculum and Evaluation Standards for School Mathematics,* National Council of Teachers of Mathematics, 1989, p. 209, 223, 228.)

Blueprint of the Assessment

Conceptual

General Learner Expectations	End-of-Course Exam question numbers	Performance Assessment task numbers
The student: • demonstrates that geometric shapes and solids have mathematical attributes.	SR 8, 9, 12, 39	
• shows that geometric shapes and solids can be measured directly and indirectly using various techniques, instruments and units, and that the accuracy of any measurement is dependent upon the instrument being used, the individual doing the measurement and the need for precision.		1
• shows how a ratio is a way of comparing the relative sizes of two quantities.	SR 3	
• defines and uses a rate as a ratio between quantities that have different units.	SR 19	
• defines and uses proportions as equations made up of equivalent ratios.	SR 3	
• defines and uses percentages as ratios in which a quantity is compared to 100.	SR 4, 5, 18, 24	
• relates probability to the likelihood of an event, and a number between 0 and 1.	SR 37, 38	
• classifies two- and three-dimensional figures.	SR 31	
• relates the angles formed by intersecting lines.	SR 29	

Continued

Mathematics 14 – Continued

Procedural

General Learner Expectations	End-of-Course Exam question numbers	Performance Assessement task numbers
The student: • uses skills in addition, subtraction, multiplication and division with whole numbers, integers and rational numbers to perform computations that can be done mentally, with paper and pencil, and with electronic calculators, as appropriate to a particular situation.	SR 1, 2, 6, 13, 20, 23	
• shows that rounding, estimation and approximation are fundamental to facility in calculation.	SR 21	
• checks an answer for reasonableness and accuracy, with the level of accuracy required dependent upon the particular situation.	WR 1, 3	
• reproduces geometric figures using construction techniques and geometric instruments.	WR 2	2
• uses standard units of measure, especially the SI system, for length, mass, and volume.	WR 1, 3	1
• calculates perimeters and areas of two-dimensional figures.	SR 27, 28, 30, 32, 40	2
• calculates volumes of three-dimensional figures.	SR 33, 34 WR 3	

Continued

Mathematics 14 – Continued

Problem-Solving

General Learner Expectations	End-of-Course Exam question numbers	Performance Assessement task numbers
The student: • organizes, presents, and analyzes sample data in order that valid population inferences can be drawn.	SR 16, 17, 25, 26, 35, 36 WR 2	3
• solves problems using the properties of similar triangles.	SR 27, 28	2
• solves problems involving Pythagoras' Theorem.		2
• calculates and displays the costs associated with traveling.	SR 24	
• uses algebraic expressions to represent and solve problem situations where one or more values may vary.	SR 7, 10, 22, 41	
• uses relationships between two variables, expressed as ordered pairs, equations, or graphs, to model and solve problems.	SR 11, 14, 15, 18, 29, 41	1

Description of Standards

The Course of Studies for Mathematics 14 states that the content consists of topics required of all students who take the course. This required content contains the concepts, skills, and attitudes that all students are expected to acquire, as well as specific expectations for problem solving and the use of technology. For complete details of the Mathematics 14 course, refer to the Course of Studies.

The Course of Studies also states that "evaluation of students in the Senior High School Mathematics program will involve assessment of the level of achievement of **all of the learner expectations, including concepts, skills and attitudes, as well as problem-solving and technological expectations**."

The assessment standards for Mathematics 14 include an acceptable and an excellent level of performance. Students' performance should be measured on a range of tasks, some designed to focus on routine and obvious tasks in familiar contexts and others designed to focus on non-routine tasks in unfamiliar contexts.

Acceptable Standard

The *acceptable standard* in Mathematics 14 would be obtained by students who receive a course mark between and including 50% and 79%. Typically, these students have gained new skills and a basic knowledge of the concepts and procedures relative to the general and specific learner expectations defined in the Mathematics 14 Course of Studies. These students can apply this knowledge to a limited range of familiar problem contexts. The *acceptable standard* identifies the degree to which learner expectations must be met for students to be successful in the demands placed in the context of the Mathematics 24 course.

Standard of Excellence

The *standard of excellence* for Mathematics 14 would be obtained by students who receive a course mark at or above 80%. Typically, these students have gained a breadth and depth of knowledge of the concepts and procedures, and the ability to apply this knowledge to a broad range of familiar and unfamiliar problem contexts. This standard signifies high-quality performance relative to the general and specific learner expectations in the Mathematics 14 Course of Studies. The *standard of excellence* identifies the degree to which learner expectations must be met for students to excel in the demands placed in the context of the Mathematics 24 course. Students who meet the *standard of excellence* can also be expected to succeed in courses that require competencies similar to those expected in courses such as Mathematics 13.

Students have reached the acceptable standard if they are able to consistently complete acceptable work on routine and obvious tasks in familiar contexts.

Students have reached the standard of excellence if they are able to consistently complete excellent work on routine and obvious tasks in familiar contexts and acceptable work on non-routine tasks in unfamiliar contexts.

Details of the relationship of assessment standards to curricular learner expectations follow.

Relationship of Assessment Standards to General Learner Expectations

Mathematical Concepts

Students relate numerical, geometric, and statistical concepts to model and solve simple mathematical problems.

Acceptable Standard

Students who meet the *acceptable standard* in Mathematics 14 have a **basic** understanding of the concepts outlined in the Course of Studies. They demonstrate their understanding in diagram and word forms, and can translate from one form to another. For example, students meeting the *acceptable standard*

- relate areas in square metres to lengths and widths expressed in metres
- can substitute integral values for variables in expressions such as $2(L + W)$

To meet the *acceptable standard*, students communicate mathematical situations in an **understandable** way, using numbers, diagrams, and appropriate everyday and mathematical terms. They understand mathematical questions presented with objects, diagrams, or numbers in **familiar** contexts, and construct mathematical models by **translating words into suitable numbers.**

Standard of Excellence

Students who meet the *standard of excellence* in Mathematics 14 have a **thorough** understanding of the concepts outlined in the Course of Studies. They demonstrate their understanding in diagram, word, and symbol forms, and can translate from one form to another. For example, students meeting the *standard of excellence*

- relate areas in square metres to lengths and widths expressed in centimetres or millimetres
- can solve for an unknown variable in expressions such as $P = 2(L + W)$.

To meet the *standard of excellence,* students communicate about mathematical situations in a **clear** way, using numbers, diagrams, and the appropriate mathematical terms. They understand mathematical questions presented with objects, diagrams, or numbers **in familiar and unfamiliar contexts**, and construct mathematical models **by translating words into suitable numbers, diagrams, and tables.**

Mathematical Procedures

Students carry out single-step and multi-step procedures to obtain estimated and exact solutions to everyday mathematical problems.

Acceptable Standard

Students who meet the *acceptable standard* in Mathematics 14 have a fluency in carrying out the **most common** procedures outlined in the Course of Studies. For example, students meeting the *acceptable standard*

- calculate the full price of a $14.50 restauarant meal, after allowing for a 15% tip and a 13% sales tax
- show that $\frac{147}{15} = 9.8$, using paper-and-pencil and calculator procedures
- calculate the perimeter of a parallelogram whose sides are 11.6 cm and 21.9 cm is 67.0 cm
- estimate that the sum of $11.3 billion and $491 million is approximately $11.8 billion

Students meeting the *acceptable standard* perform the mathematical operations and procedures that are fundamental to daily living contexts.

Standard of Excellence

Students who meet the *standard of excellence* in Mathematics 14 have a fluency in the **full range** of the procedures outlined in the Course of Studies. For example, students meeting the *standard of excellence*

- calculate the original price of a restaurant meal, given that the total is $21.87 after a 15% tip and a 13% sales tax
- show that $\frac{147}{15} = 9.8$ can also be expressed as $\frac{147}{15} = 9$, remainder 12
- calculate the length of wallpaper, 90 cm wide, needed to cover an area of 7.65 m^2
- estimate the numerical value of $\frac{21.4}{14.2 \times (31.6 - 27.0)}$ and verify the estimate using a calculator

Students meeting the *standard of excellence* perform the mathematical operations and procedures that are fundamental to daily living contexts, and **provide alternative solution procedures to verify results.**

Problem Solving

Students solve consumer and everyday problems by using different mathematical procedures and strategies, employing both numerical and geometrical methods.

Acceptable Standard

Students who meet the *acceptable standard* in Mathematics 14 have a **basic** understanding of **some routine, problem-solving applications** of the required content outlined in the Course of Studies. For example, students meeting the *acceptable standard*

- convert a data table format of a budget into a circle graph format
- calculate the volume of a cylinder, given its diameter and height
- calculate the number of matches required to complete a sports tournament

To meet the *acceptable standard*, students are expected to communicate mathematical situations in an **understandable** way, using numbers, diagrams, and appropriate everyday terms.

Students meeting the *acceptable standard* apply what they know in solving **straightforward problems in familiar settings** and in analyzing simple mathematical models. They describe the steps they used to solve a particular problem, and to defend their solution to the problem.

Standard of Excellence

Students who meet the *standard of excellence* in Mathematics 14 have a **thorough** understanding of **both routine and non-routine problem-solving applications** of the required content outlined in the Course of Studies. For example, students meeting the *standard of excellence*

- use an equation and a graph to model situations such as the masses of different volumes of water in a beaker
- calculate the dimensions of a rectangle from its area and its perimeter
- summarize a pattern of numbers in terms of variables, and use the pattern to make predictions

To meet the *standard of excellence,* students communicate mathematical situations in a **clear** way, using numbers, diagrams, **symbols**, and any relevant **mathematical** terms.

Students meeting the *standard of excellence* apply what they know in solving **routine and nonroutine problems in a broad range of settings**. They describe the steps they used to solve a particular problem, defend their solution to the problem, and, **where appropriate, provide alternative solution procedures to verify results.**

Administering and Scoring the Assessment Components

- *General Scoring Criteria for Mathematical Content*
- *General Scoring Criteria for Communication Skills*
- *End-of-Course Exam*
- *Performance Assessment*

Mathematics 14

General Scoring Criteria for Mathematical Content

These scoring criteria should be shared with students so that they are fully familiar with these criteria guide before they participate in the assessment. These criteria are used as a basis for the task-specific scoring criteria that are used to assess students' responses to particular extended-response items, whether written-response questions or performance tasks.

Scale score	Criteria
5	Complete answer, with supporting detail shown. Final answers are correct, and the communication is readily understandable.
4	Complete answer, but with minor errors present. Final answers may be incorrect, and the communication may lack some clarity.
3	**Either** a partial answer that is complete and correct as far as it goes, and represents a major step in the solution of the question; **or** a complete answer that has one major error **or** many minor errors present, but does indicate the full intended scope of the question
2	**Either** a partial answer that is complete and correct (except for minor errors) as far as it goes, and represents a major step in the solution of the question; **or** more than one correct answer, with no supporting detail; **or** a complete answer that has one major **and** many minor errors present, but does indicate either the full intended scope of the question or a strategy that could produce a complete response to the question
1	**Either** one correct answer, with no supporting detail; **or** a significant start made to the problem
0	**Either** off-topic; **or** an incorrect answer with no supporting detail; **or** a fatal error present. Fatal errors, whether conceptual or procedural, are those errors that destroy the integrity of the original question, often making it completely trivial; **or** a blank paper.

Mathematics 14

General Scoring Criteria for Communication Skills

These scoring criteria should be shared with students so that they are fully familiar with these criteria before they participate in the assessment. These criteria are used as a basis for the task-specific scoring criteria that are used to assess students' responses to particular performance tasks.

The scores on this scale must be assigned **independently** of the scores on the mathematical content scale.

Scale score	Criteria
3	A clear solution that includes all relevant elements, such as hypotheses, data tables, and graphs, shows the results of any computations in a systematic, ordered manner, and includes full concluding statements. The solution generally respects the normal conventions of mathematical communications in such matters as arrangement of data tables, axis labeling, graph drawing, and graph titling. Few, if any, gaps are left to be filled in by the reader.
2	A solution that includes some of the relevant elements, such as hypotheses, data tables, and graphs, shows the results of any computations in some manner, and includes some form of concluding statement. The solution makes an attempt to respect the normal conventions of mathematical communications in such matters as arrangement of data tables, axis labeling, graph drawing, and graph titling. Some gaps are left to be filled in by the reader.
1	A solution that may provide a data table, shows the results of any computations in a somewhat disorganized manner, and may not even include any form of concluding statement. The solution makes little attempt to respect the normal conventions of mathematical communications in such matters as arrangement of data tables, axis labeling, graph drawing, and graph titling. Large gaps are left to be filled in by the reader.
0	**Either** insufficient evidence of communication skills; **or** a numerical answer (correct or incorrect) with no supporting calculations; **or** a blank paper.

Mathematics 14

End-of-Course Exam

Administration

This requires two hours of class time and is a closed-book exam. Students **are** given a formula sheet but must provide their own calculator and protractor. They are expected to work on their own.

Item Summary

ITEM #	MARK VALUE	ANSWER	QUESTION STYLE	ITEM #	MARK VALUE	ANSWER	QUESTION STYLE
SR 1	1	C	basic	SR 22	1	C	basic
2	1	C	basic	23	1	C	basic
3	1	D	basic	24	1	B	basic
4	1	B	basic	25	1	C	basic
5	1	C	basic	26	1	D	complex
6	1	D	basic	27	1	B	complex
7	1	A	basic	28	1	C	complex
8	1	C	basic	29	1	B	basic
9	1	A	basic	30	1	C	basic
10	1	D	basic	31	1	D	basic
11	1	C	complex	32	1	A	complex
12	1	C	basic	33	1	B	complex
13	1	D	basic	34	1	B	basic
14	1	B	complex	35	1	B	complex
15	1	C	complex	36	1	B	basic
16	1	B	basic	37	1	A	basic
17	1	B	basic	38	1	A	basic
18	1	A	complex	39	1	D	basic
19	1	A	complex	40	1	A	complex
20	1	C	basic	41	1	D	basic
21	1	B	basic				

WR 1	5		4 basic; 1 complex
2	5		3 basic; 2 complex
3	5		3 basic; 2 complex

Continued

Mathematics 14 – Continued

By Question Type

QUESTION TYPE	MARKS	PERCENT EMPHASIS
Selected Response	**41**	**73**
Written Response	**15**	**27**

By Question Style

QUESTION STYLE	MARKS	PERCENT EMPHASIS
Basic or Routine	**39**	**70**
Complex or Non-Routine	**17**	**30**

Written Response 1: Student Task and Solution

(5 marks) **1.** A piece of photocopying paper is very thin, and its thickness cannot be measured directly. A 500-sheet package of photocopying paper measures 28 cm long × 22 cm wide × 5.1 cm thick. A 200-sheet box of facial tissues measures 22 cm long × 12 cm wide × 7.2 cm thick.

a. Calculate the thickness of one sheet of photocopying paper.

Solution

1 sheet is (5.1 cm)/500, or **0.0102 cm thick**

b. Calculate the thickness of one facial tissue, and explain why this calculated answer is likely to be very inaccurate.

Solution

Just taking the thickness of 200 sheets, 7.2 cm, and dividing it by 200 gives a **thickness of 0.036 cm** that is 3.5 times as thick as regular photocopying bond paper.

This does not allow for the air pockets and the double folding found in the loose packing of tissues in their boxes.

Task-Specific Scoring Criteria for Written Response 1

Scale score	Criteria
5	Complete answer to both parts, with supporting explanation shown. Final answers are correct, including units, and the communication is readily understandable.
4	**Either** final answers may be incorrect, and the communication may lack some clarity; **or** final numerical answers to both parts are correct, but either the explanations are inadequately supported, or imprecisely expressed, or the units are omitted.
3	**Either** a complete answer that has one major error **or** many minor errors present, but that indicates the calculation strategy, the approximate value of the thickness, and the written explanations in support; **or** the final numerical answers to both parts are correct, but they are poorly supported by written explanations, with many gaps needed to be filled in by the reader.
2	**Either** a reasonable value for the thickness in either part with some supporting detail; **or** a correct numerical answer to each part, with no supporting explanation.
1	A significant start made to the solution of the problem. Examples of significant starts include, but are not limited to, attempts at explaining the calculation strategy used, or awareness of the differences between bond paper and tissue, or a calculation of the thickness that involves a division.
0	**Either** off-topic; **or** an unreasonable estimate in part a., with no supporting detail; **or** a blank paper.

Written Response 2: Student Task and Solution

(5 marks) **2.** The following chart appeared in a weekend edition of a local newspaper. The chart indicates the favorite sorts of music of people who read three different newspapers from three different geographic areas.

Music Choices of 1995			
Type of Music	**Edmonton Journal**	**Calgary Herald**	**The Globe and Mail**
Rock and Roll	12	15	20
Western	13	55	15
Alternative	27	4	11
Rap	11	2	2
Classical	0	8	27
Reggae	26	3	5
Pop	6	7	4
Heavy Metal	5	6	6
Total	100	100	90

a. How does the chart show that readers of each of the three newspapers have **different** musical tastes?

Solution

Readers of the **Edmonton Journal** like Alternative and Reggae more than do readers of the other two papers (27% and 26%, compared with 4% and 3%, or with 12% and 5%).

Readers of the **Calgary Herald** like Western more than do readers of the other two papers (55% compared with 13% and 7%).

Readers of the **Globe and Mail** like Classical more than do readers of the other two papers (30% compared with 0% and 8%).

The tastes in Rock and Roll, Pop, Heavy Metal, and possibly Rap are roughly the same in the three centres.

b. Prepare a circle graph (pie chart) showing the music preferences of the 90 Globe and Mail readers. Show calculations of sector angles in the space provided, and use the circle below for your completed work.

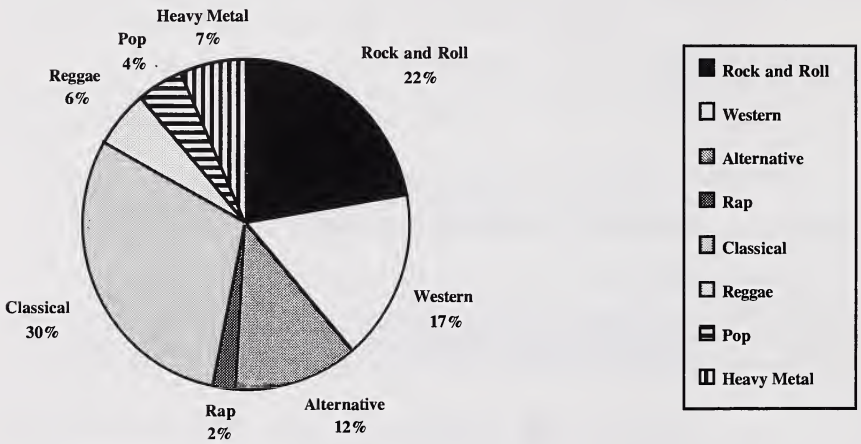
Solution

The Globe and Mail sample is 90, so each member of the sample corresponds to $\frac{360}{90}$, or 4.0°.

So Rock and Roll corresponds to 80°, Western to 60°, Alternative to 44°, Rap to 8°, Classical to 108°, Reggae to 20°, Pop to 16°, and Heavy Metal to 24°.

The circle graph is shown below.

Music Preferences of 90 Globe and Mail Readers



Task-Specific Scoring Criteria for Written Response 2

Scale score	Criteria
5	Complete and correct answer to both parts, with supporting detail shown. Final answers are correct, the conclusions are strictly supported by the data, and the communication is readily understandable.
4	Complete answer to both parts, with supporting detail shown. Final answers are correct, the conclusions are reasonably consistent with the data, and the communication is generally understandable. Minor errors may be present in the details.
3	**Either** a complete answer that has one major error **or** many minor errors present, but that indicates the reading of the data table, the calculation of the sector angles, the drawing of the pie graph, and the written explanations in support; **or** a complete and correct pie graph; **or** a set of conclusions that are supported by the data, with little significant attempt at a pie graph.
2	**Either** an answer that has major errors present, but that indicates some reading of the data table, an attempt at the calculation of the sector angles, a rough drawing of a pie graph, and some written explanations in support; **or** a complete pie graph, with minor errors in the calculation of the sector angles; **or** a set of conclusions that are approximately supported by the data, with no attempt at a pie graph.
1	A significant start made to the solution of the problem. Examples of significant starts include, but are not limited to, the calculation of one or more sector angles, or the construction of a pie graph which includes a sector for each category, or a summary paragraph that makes some reference to data that are in the chart or in the pie graph.
0	**Either** off-topic; **or** an unreasonable estimate in part a., with no supporting detail; **or** a blank paper.

Written Response 3: Student Task and Solution

(5 marks) **3.** Woody works in a hamburger restaurant. The restaurant uses toothpicks to hold the hamburgers together. Woody's boss found an excellent buy on a million toothpicks, and asked Woody to pick them up. This sounded like a lot of toothpicks. Woody wondered if a packing case containing these toothpicks would fit into the trunk of his small car.

a. One box holds 250 toothpicks. A carton holds 20 boxes. How many toothpicks does this carton hold?

Solution

(20 boxes/carton)(250 toothpicks/box)= **5 000 toothpicks**

b. How many cartons are needed to build a stack containing one million toothpicks?

Solution

1 million toothpicks is (1 000 000/5 000) or **200 cartons**

c. One box of toothpicks measures 5.2 cm long × 2.7 cm wide × 1.3 cm high, and a carton of 20 boxes measures 10.4 cm long × 13.5 cm wide × 2.6 cm high.

What could be the dimensions of a packing case that holds a million toothpicks?

The trunk of Woody's car measures 0.7 m long × 1.3 m wide × 0.4 m high. Will this packing case fit into the car trunk?

Solution 1 using cartons

200 cartons could be 10 long by 5 deep by 4 high
Dimensions would be (10 × 10.4 cm) × (5 × 13.5 cm) × (4 × 2.6 cm)
This is 1.04 m long by 0.675 m deep by 10.4 cm high, and this fits the car trunk easily

Solution 2 using boxes

4 000 boxes could be 25 long by 20 deep by 8 high
Dimensions would be (25 × 5.2 cm) × (20 × 2.7 cm) × (8 × 1.3 cm)
This is 1.3 m long by 0.54 m deep by 10.4 cm high, and this fits the car trunk easily

Note that these solutions are not unique, and that there are many ways of fitting one million toothpicks into the car trunk.

Task-Specific Scoring Criteria for Written Response 3

Scale score	Criteria
5	Complete answers to all parts, with supporting detail shown. Final answers are correct, and the communication is readily understandable.
4	**Either** a complete and numerically correct answer to all three parts, with supporting detail shown, and having a packing case that holds a million toothpicks, but with little or no attempt to fit the case into the car trunk; **or** a complete answer to all three parts, with supporting detail shown, having a packing case that holds at least a million toothpicks, and which fits in the car trunk. Any calculation errors present still require the design of a packing case that fits into a car trunk, and that holds the calculated number of toothpicks
3	**Either** a complete answer that has one major error **or** many minor errors present, but that indicates the calculation of the dimensions of a carton, the number of boxes needed to hold a million toothpicks, and the dimensions of the packing case; **or** a correct answer to one or two parts, with supporting detail shown and making an attempt either to find the volume or dimensions of a packing case that holds a million toothpicks, or a packing case that fits in the car trunk
2	**Either** two correct numerical answers, with or without support; **or** reasonable answers to the first two parts, together with an attempt to find the volume or the dimensions of either the carton or the packing case
1	**Either** one correct numerical answer, with or without support; **or** a significant start made to the solution of the problem. Examples of significant starts include, but are not limited to, a calculation of the number of toothpicks in a carton, or an attempt to find the number of boxes or the number of cartons needed to hold a million toothpicks
0	**Either** off-topic; **or** an unreasonable answer in part a. or part b., with no supporting detail; **or** a blank paper.

Performance Assessment

Administration

This requires 1.5 hours of class time and is a closed-book examination. Students are given a formula sheet but must provide their own calculations or calculators. Students are expected to work on their own.

The room should be set up with one station for every three students. Students need to be at the station for the data gathering in Task 1, but can do the calculations for Task 1 at their desks. They can do everything for Tasks 2 and 3 at their desks.

Students will need a ruler and a sharp pencil for the drawings needed in Tasks 2 and 3.

Equipment Needed (per station)

Measuring cylinder (100 mL or larger).....1
Marbles or similar identical objects .....12 to 15
Water supply

The marbles must be identical to each other; the precise volume of the marbles is not critical. The best results come with marbles of diameter 2 cm or thereabouts.

Classroom Management

At the start of the testing period, about one third of the class should be sent up to gather data for Task 1. One student is to be sent to each station. The other two thirds of the students should be directed to start the assessment with either Task 2 or Task 3.

The data gathering should take a maximum of five minutes. After the initial group of students has completed their data gathering, other students can go up to any vacant station when they are ready.

Students should clean up their stations after they have finished gathering their data for Task 1.

Except for unusual circumstances, students should do their own measuring and data gathering in Task 1.

Scoring the Assessment

Each task is scored out of a possible eight marks. Five of these marks are from the Mathematical Content scale, and the other three from the Communication Skills scale.

Task 1: Objects in a Measuring Cylinder
Student Task and Solution

If solid objects are placed in a jar of water, the water level will rise. The more objects that are placed in the jar, the more the water level will rise. This investigation is designed to relate the rise in water level to the number of identical objects placed in the jar. After taking your measurements and drawing a graph, you have to make some predictions.

Student instructions and information

Part 1: **a.** Fill your measuring cylinder half full of water.

b. Measure the volume of the water to the nearest millilitre. Record the result in a chart.

c. Put one object in the measuring cylinder.

d. Measure the new volume of the water and record the result in the chart.

e. Repeats steps c. and d. several times.

Part 2: Complete your chart of measurements.

Part 3: Display your results in an appropriate graph. The graph should have measured volume on the vertical axis and the number of objects on the horizontal axis.

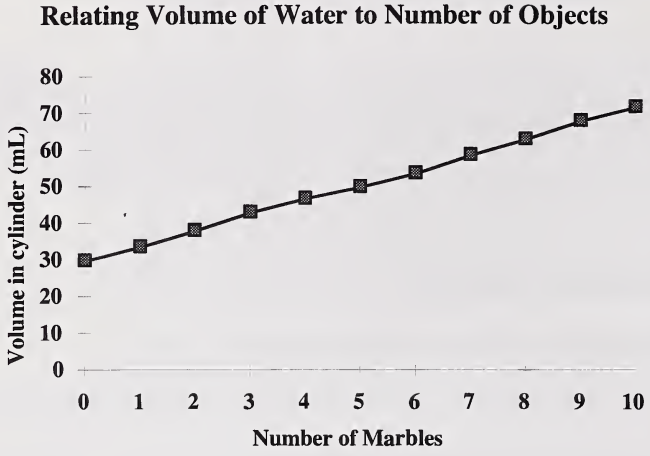
Chart of measurements

Solution

Number of Marbles	Volume of Water (mL)
0	30
1	34
2	38
3	42
4	47
5	51
6	55
7	58
8	62
9	66
10	70

Graph Of Water Volume And Number Of Objects

Solution



Predictions

Average volume of one object:

Solution

From the graph, 10 marbles occupy (72 – 30) mL, or 42 mL

So **volume of 1 marble = 4.2 mL**

Volume in the measuring cylinder if 20 objects have been put in the water:

Solution

30 mL + 20 × 4 mL = **110 mL by extrapolation**

Mathematics 14

Task-Specific Scoring Criteria for Task 1

Mathematical Content Scale

Scale Score	Criteria
5	A complete and correct solution, with measurement table completed, a line or bar graph drawn, and predictions and conclusions made that follow from the data obtained
4	**Either** the task is complete, with the measurements table completed, a line or bar graph (not necessarily best-fit) drawn, and predictions and conclusions drawn from the data. There may be minor omissions, inaccuracies, or errors in the details of the data treatment and the drawing of conclusions; **or** the task is correct but incomplete, with the measurements table completed, a line or bar graph (not necessarily best-fit) drawn, and either a reasonable prediction of the 20-marble volume or a reasonable conclusion for the volume of a single marble drawn from the measurement table or the graph
3	**Either** the task is complete, with the measurements table completed, a line or bar graph drawn, and conclusions drawn from the data. There are significant omissions or errors in the details of the data treatment and the drawing of conclusions; **or** a completed, correct measurement table, together with some form of line or bar graph, but with little attempt to draw any systematic conclusions
2	**Either** a completed, correct, measurement table; **or** an answer that shows an ability to follow the question directions, so as to produce a measurement table, a graph, and some conclusions. However, the number of errors present in the solution render all the data treatments unreliable
1	A significant start made to the problem, such as (but not limited to) the setting up of a measurement table, together with one or two data points, or the drawing of a line graph, or a reasonable prediction of either the 20-marble volume or the volume of a single marble
0	**Either** off-topic; **or** a blank paper.

Continued

Mathematics 14 – Continued

Communication Skills Scale

This scale is used **independently** of the mathematical content scale. A well-laid-out, systematic strategy with conclusions clearly stated can receive a scale score of 3, even if the comparison itself is based on data that either contain gross errors in the calculations of the supporting numbers, or reflect serious errors in measurement.

Scale Score	Criteria
3	A clear solution that includes a data table, shows the results of any computations in a systematic, ordered manner, and includes full concluding statements. The line or bar graph generally respects the normal conventions of axis labeling, graph drawing, and graph titling. Few, if any, gaps are left to be filled in by the reader.
2	A solution that includes a data table, shows the results of any computations in some manner, and includes some form of concluding statement. The line or bar graph makes an attempt to respect the normal conventions of axis labeling, graph drawing, and graph titling. Some gaps are left to be filled in by the reader.
1	A solution that may provide a data table, shows the results of any computations in a somewhat disorganized manner, and may not even include any form of concluding statement. The line or bar graph makes little attempt to respect the normal conventions of axis labeling, graph drawing, and graph titling. Large gaps are left to be filled in by the reader.
0	**Either** insufficient evidence of communication skills; **or** a blank paper.

Task 2: Determining the Area of a Quadrilateral Student Task and Solution

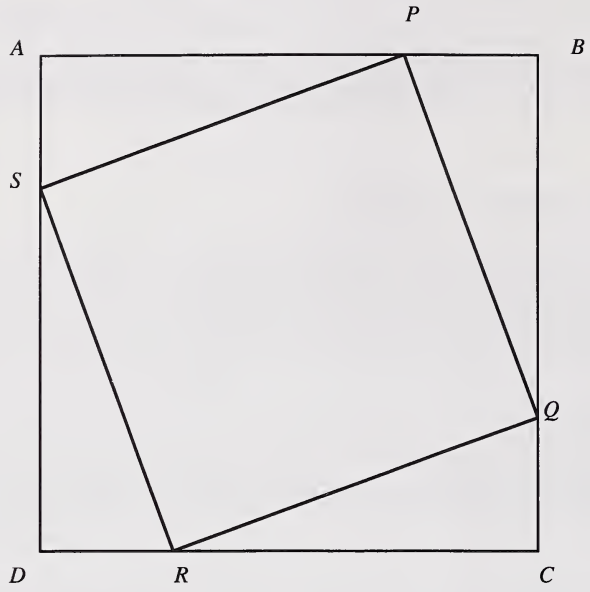
A drawing has been started on the facing page. The points A, B, P, and D have been marked. The distances AB and AD are both 15 units, and the distance AP is 11 units. To complete the drawing:

1. Mark the point C so that $ABCD$ is a square.
2. Mark the point Q on BC, so that the distance BQ is 11 units.
3. Mark the point R on CD, so that the distance CR is 11 units.
4. Mark the point S on DA, so that the distance DS is 11 units.
5. Join the points P, Q, R, and S.

The problem is to determine the area of the quadrilateral $PQRS$ in **two** different ways.

Finished Work

Drawing:



Calculations (remember to show your work):

Area of quadrilateral *PQRS*:

Solution

The area is the area of square *ABCD* less four times the area of triangle *QCR*.

So area is (15)(15) – 4(0.5)(11)(4) or 225 – 88 or **137 square units**

Area of quadrilateral *PQRS* (using an alternative method):

Solution

The area is the square of the distance *PQ*.

Use Pythagoras to find PQ^2. Here $PQ^2 = PB^2 + BQ^2$

So $PQ^2 = 4^2 + 11^2$, or **137 square units**

By counting squares directly, the area would be somewhere between **130 and 140 square** units, depending on whether each partial square is interpolated, or is automatically counted as a half-square.

Mathematics 14

Task-Specific Scoring Criteria for Task 2

Mathematical Content Scale

Scale score	Criteria
5	A complete and correct solution, consisting of an accurate drawing, a clear indication of the shape of *PQRS*, and the area calculated in two distinct ways.
4	**Either** a correct solution consisting of an accurate drawing, including some description of the shape of *PQRS*, but with the area calculated in only one way; **or** a complete solution, consisting of an accurate drawing, a description of the shape of *PQRS*, and the area calculated in two distinct ways. There are minor errors in measurement or calculation present.
3	**Either** a solution, containing minor errors, consisting of an accurate drawing, an implied description of the shape of *PQRS*, but with the area calculated in only one way; **or** a complete solution, consisting of a drawing, a description of the shape of *PQRS*, and the area calculated in two distinct ways. There are significant errors in measurement and calculation present.
2	**Either** a solution that consists of an accurate drawing, with no significant progress in the area calculations; **or** a reasonable attempt to calculate the area *PQRS* in two distinct ways, but starting from an inaccurate or incomplete drawing.
1	A significant start on the problem. Examples of significant starts include (but are not limited to) drawing a square *ABCD* of the correct shape and dimensions, or using formulas such as the area of a rectangle, area of a triangle, or Pythagoras' Theorem, or assigning a consistent name to the shape of the quadrilateral *PQRS*.
0	**Either** off-topic; **or** a blank paper.

Continued

Mathematics 14 – Continued

Communication Skills Scale

This scale is used **independently** of the mathematical content scale. A well-drawn, fully labeled drawing can receive a scale score of 2, even if the supporting calculations are incorrect, or insufficiently well explained.

Scale Score	Criteria
3	A clear solution that includes a completed drawing that generally respects the normal conventions of labeling of points, and of line drawing. The solution shows the results of any computations in a systematic, ordered manner, and includes full concluding statements. Few, if any, gaps are left in drawings or calculations.
2	A solution that includes a completed drawing that makes an attempt to respect the normal conventions of labeling of points, and of line drawing. The solution shows the results of any computations in some manner, and may include some form of concluding statement. Some gaps, in both drawing and calculation, are left to be filled in by the reader.
1	A solution that may provide a completed drawing that makes little attempt to respect the normal conventions of labeling of points, and of line drawing. The solution shows the results of any computations in a somewhat disorganized manner, and may not even include any form of concluding statement. Large gaps are left to be filled in by the reader.
0	**Either** insufficient evidence of communication skills; **or** a blank paper.

Task 3: Does One 12-Sided Die Equal Two 6-Sided Dice? Student Task and Solution

Procedure

Throw the 12-sided die 50 times and record the results in the third column of the first tally chart below. Combine these results with the results of the 50 throws that have already been entered in the second column of the tally chart. Record the total frequency in the fourth column of the tally chart.

Throw the pair of 6-sided dice 50 times and record the results in the third column of the second tally chart below. Combine these results with the results of the 50 throws that have already been entered in the second column of the tally chart. Record the total frequency in the fourth column of the tally chart.

Draw a frequency graph or histogram from **each** one of the tally charts.

Tally Charts

Solution

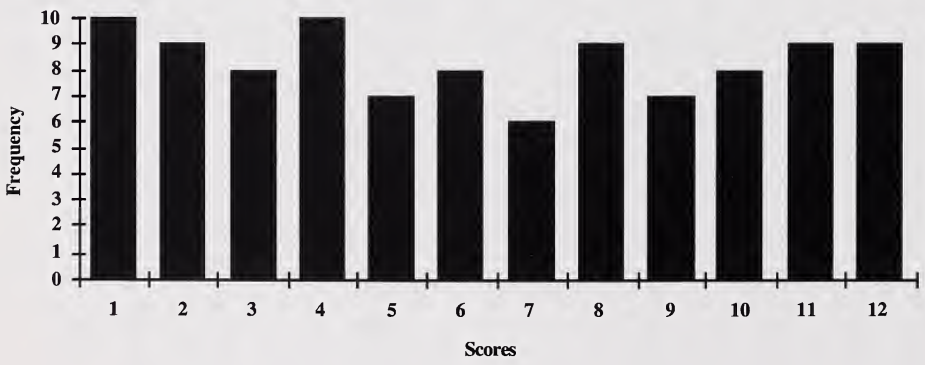
Chart 1: 12-sided die			
Score (12-sided die)	Frequency (first 50)	Tallies for second 50	Total frequency
1	3	11111 11	10
2	5	1111	9
3	4	1111	8
4	4	11111 1	10
5	6	1	7
6	3	11111	8
7	5	1	6
8	3	11111 1	9
9	2	11111	7
10	6	11	8
11	5	1111	9
12	4	11111	9

Chart 2: Pair of 6-sided dice			
Score (6-sided dice)	**Frequency (1st 50)**	**Tallies for second 50**	**Total frequency**
1	0		0
2	2	1	3
3	2	111	5
4	3	11111	8
5	6	11111	11
6	7	11111 11	14
7	9	11111 1111	18
8	7	11111 1	13
9	5	11111 11	12
10	5	1	6
11	3	111	6
12	1	111	4

Frequency Graph or Histograms

Solution

Frequency Graph for 100 Rolls of One 12-Sided Die



Frequency Graph for 100 Rolls of Two 6-Sided Dice

Conclusions

Use one or two sentences to describe how the graphs look the same, or how the graphs look different.

Solution

The pair of 6-sided dice give a pattern that favors scores in the middle of the range, such as 6, 7, and 8. Also the score of 1 is impossible.

The 12-sided die gives a more random pattern, and the score of 1 is possible.

Mathematics 14

Task-Specific Scoring Criteria for Task 3

Mathematical Content Scale

Scale score	Criteria
5	A complete and correct solution, with both tally charts completed, frequency graphs drawn, and conclusions made that follow from the data obtained.
4	The task is complete, with both tally charts completed, frequency graphs drawn,but with no conclusions drawn from the data. There are minor omissions or errors in the details of the data treatment, but the omissions or errors can be easily rectified.
3	**Either** the task is complete, with both tally charts completed, frequency graphs drawn, but with no conclusions drawn from the data. There are significant omissions or errors in the details of the data treatment and the drawing of conclusions; **or** a completed, correct set of tally charts, together with a start made on the frequency graphs, and little attempt to draw any systematic conclusions
2	**Either** a completed, correct set of tally charts; **or** an answer that shows an ability to follow the question directions, producing tally charts, frequency graphs, and conclusions. However, the number of errors present in the solution render all the data treatments unreliable
1	A significant start made to the problem, such as (but not limited to) the completion of one observation chart, or the identification of crucial facts, like the rolling of a 1 only being possible for the 12-sided die, or the conversion of any form of observation chart into a frequency graph
0	**Either** off-topic; **or** a blank paper.

Continued

Mathematics 14 – Continued

Communication Skills Scale

This scale is used **independently** of the mathematical content scale. A well-laid-out, systematic strategy with conclusions clearly stated can receive a scale score of 3, even if the comparison itself is based on data that either contain gross errors in the calculations of the supporting numbers, or reflect serious errors in data recording.

Scale score	Criteria
3	A clear solution that includes both tally charts, and includes full concluding statements. The bar, line, or pie graphs generally respect the normal conventions of axis labeling, graph drawing, and graph titling. Few, if any, gaps are left to be filled in by the reader.
2	A solution that includes both tally charts, and includes some form of concluding statement. The bar, line, or pie graphs make an attempt to respect the normal conventions of axis labeling, graph drawing, and graph titling. Some gaps are left to be filled in by the reader.
1	A solution that may provide one or both tally charts, and may not even include any form of concluding statement. The bar, line, or pie graphs make little attempt to respect the normal conventions of axis labeling, graph drawing, and graph titling. Large gaps are left to be filled in by the reader.
0	**Either** insufficient evidence of communication skills; **or** a blank paper.

Calculating and Recording Student Achievement

- *Standards for Overall Performance on the Assessment*
- *Class Record Form*
- *Item Summary — Overall Assessment*
- *Directing Words*

CLASSROOM
ASSESSMENT
MATERIALS

Mathematics 14

Standard for Overall Performance on the Assessment

Scoring criteria for each component of the assessment are provided in the teacher intructions for each component. Assessment standards for the overall performance of a student on the whole package are as follows:

Not Yet at Acceptable Standard (NS)	Acceptable Standard (AC)	Standard of Excellence (EX)
0-49% on the total score	**50% - 79% on the total score**	**80% - 100% on the total score**

Standards for the assessment were established and validated using the scoring criteria outlined for each task. If the tasks are scored using different criteria or used for purposes other that assessing achievement at the end of Mathematics 14, these standards may not be appropriate.

The standards for performance on the assessment apply to all students. Professional judgement should be used to make adjustments to administration procedures so that special needs students are able to demontrate their best work.

Class Record Form

	A	B	A + B	A + B (%)	
Student Name	**End-of-Course Exam (56)**	**Performance Assessment (24)**	**Overall weighted achievement (80)**	**Overall percentage weighted achievement** $\frac{A+B}{80} \times 100\%$	**Standard***

* The standards for this assessment package are as follows.

Not Yet at Acceptable Standard (NS)	Acceptable Standard (AC)	Standard of Excellence (EX)
0-49%	50% - 79%	80% - 100%

Item Summary – Overall Assessment

By Question Type

QUESTION TYPE	MARKS	PERCENT EMPHASIS
Selected Response	**41**	**51**
Written Response	**15**	**19**
Performance-Based Task	**24**	**30**

By Question Style

QUESTION STYLE	MARKS	PERCENT EMPHASIS
Basic or Routine	**56**	**70**
Complex or Non-Routine	**24**	**30**

Directing Words

Discuss
The word "discuss" will not be used as a directing word on mathematics classroom assessments because it is not used consistently to mean a single activity.

The following words are specific in meaning:

Contrast/Distinguish
Point out the *differences* between two things that have similar or comparable natures.

Compare
Show the character or relative values of two things by pointing out their similarities and differences.

Conclude
State a logical end based on reasoning and/or evidence.

Criticize
Point out the merits and demerits of an item or issue.

Define
Provide the essential qualities or meaning of a word or concept. Make distinct and clear by marking out the limits.

Describe
Give a written account or represent the characteristics of something by a figure, model, or picture.

Design/Plan
Construct a plan; i.e., a detailed sequence of actions for a specific purpose.

Enumerate
Specify one by one or list in concise form and according to some order.

Evaluate
Give the significance or worth of something by identifying the good and bad points or the advantages and disadvantages.

Explain
Make clear what is not immediately obvious or entirely known; give the cause of or reason for; make known in detail.

How
Show in what manner or way, and with what meaning.

Hypothesize
Form a tentative proposition intended as a possible explanation for an observed phenomenon; i.e., a possible cause for a specific effect. The proposition should be testable logically and/or empirically.

Identify
Recognize and select as having the characteristics of something.

Illustrate
Make clear by giving an example. The form of the example must be specified in the question; i.e., word description, sketch, or diagram.

Infer
Form a generalization from sample data; arrive at a conclusion by reasoning from evidence.

Interpret
Tell the meaning of something; present information in a new form that adds meaning to the original data.

Justify/Show How
Show reasons for or give facts that support a position.

Outline
Give, in an organized fashion, the essential parts of something. The form of the outline must be specified in the question; i.e., lists, flow charts, concept maps.

Predict
Tell in advance on the basis of empirical evidence and/or logic.

Prove
Establish the truth, validity, or genuineness of something by giving formal logical reasons.

Relate
Show logical or causal connection between things.

Show
Establish the truth, validity, or genuineness of something by giving reasons. The format of the demonstration can take various forms, from algebraic derivations and formal logic to geometrical and numerical examples.

Solve
Give a solution for a problem; i.e., explanation in words and/or numbers.

Summarize
Give a brief account of the main points.

Trace
Give a step-by-step description of the development.

Why
Show the cause, reason, or purpose.

Manufactured and Distributed by
Education Advantage Inc.

To order call Toll Free
1-888-544-CAMP(2267)